U. S. FOREST SERVICE
RESEARCH NOTE PSW-123

PACIFIC SOUTHWEST
FOREST & RANGE EXPERIMENT STATION
1966
P.O. Box 245 Berkeley, California 94701

INTERMOUNTAIN STATION
Central Records File
No. 0.73

Slash Decomposition . . .

laboratory tests fail to confirm acceleration by chemical treatment [1]

JOHN C. HENDEE HARRY E. SCHIMKE
BEN S. BRYANT JAMES L. MURPHY

ABSTRACT: A commercial compound said to accelerate decomposition of logging slash, is under test in field and laboratory. At the end of the first year, the field test showed some differences between treated and untreated slash which might be related to decomposition by the chemical, but follow-up laboratory studies indicated no significant value as an accelerator of decomposition.

Chemical compounds to hasten the decomposition of logging slash have been tried at various times on National Forests in the West. One such compound is called "Reynolds No Fire #CA15."[2] Results from using it in slash disposal work have been conflicting. The manufacturer claims that this dark oily liquid when diluted and sprayed on slash will speed up decomposition by prematurely releasing lignins and resins. This chemical action purports to create a better environment for naturally occurring, wood-decomposing microorganisms.

To test the possible usefulness of this product in slash disposal a field study was started in 1962. Results after a year showed some differences between treated and control samples that might be related to the effects of the compound. Laboratory studies were then made to determine to what extent the compound promoted decomposition and the nature of the process involved. Results showed that "No Fire" was of insignificant value as an accelerator of slash decomposition. But in view of initial field results field tests are scheduled to be continued for four more years.

Field Study

The test site consisted of six 1/10-acre plots of pole-sized mixed conifers and clearcut timber stands on the Sierra Nevada westside in central California. Two plots were located in a thinned stand, two in a clearcut area, and one in each served as a control. A 1/4-chain buffer strip separated all plots.

In July 1962 the plots to be treated were sprayed at a rate of about 500 gallons per acre with a mixture of 1 gallon of chemical in 500 gallons of water. This was the mixture and rate of application recommended by the manufacturer. Control plots were not treated.

Results of Field Study

At the end of the first year, we found the following differences between treated and untreated plots:

- Needles could be stripped more easily from their twigs and a greater proportion of needles were on the ground in the treated plots than in the untreated plots.

- Treated samples (diameters of 1/4, 1/2, and 1 inches) chosen at random in

[1] The laboratory phase of this study was conducted by this Station in cooperation with the University of Washington. The authors gratefully acknowledge the contributions of Professor Daniel E. Stuntz of the University's Department of Botany; of Chung-Yun Hse, of the College of Forestry; and Daniel Karpen, a National Science Foundation High School summer research fellow.

[2] Trade names and commercial enterprises or products are mentioned solely for necessary information. No endorsement by the U.S. Department of Agriculture or the University of Washington is implied.

LIBRARY FILE COPY

all size classes were darker than samples from untreated plots. Treated samples averaged one color value different from controls (Munsell Plant Color Chart), but were of the same hue.

- Treated needles and twigs were fractured more easily than untreated samples and did not have the flexible characteristics of samples from the untreated plots. Treated cedar (*Libocedrus decurrens*) needles crumbled under slight hand pressure.

- Treated slash had settled 1 foot lower than untreated slash.

- Comparisons made by observations and by slow-motion time lapse films of controlled burning of treated and untreated slash showed no obvious differences.

- Treated limbwood samples consistently had a lower bulk density (water displacement method) than those from the untreated--particularly in the 1/4-inch diameter class (table 1). But these differences were not statistically significant.

- Fuel values determined by bomb-calorimetric measurements of random samples were higher in treated plots than in untreated (table 2). These differences, though small, were statistically significant (95 percent level).

Lower bulk densities in treated samples could indicate decomposition. Higher fuel values in treated samples could be caused by the decomposition and leaching of some wood constituents of low fuel values, such as sugars, leaving residual wood constituents of high fuel value, such as resins. And the chemical itself could have added fuel value to treated samples.

Laboratory Study

To determine the mechanisms involved in accelerating decomposition with "No Fire" and the effects of different concentrations of it on decomposition, laboratory tests were conducted at the College of Forestry, University of Washington, Seattle. The tests compared the effects of two concentrations of the compound on the decomposition of Douglas-fir (*Pseudotsuga menziesii*) samples with the effects of treatments using distilled water or hydrochloric acid.

Acid Effects of Treatment

The decomposition of wood by biological processes, acid, and fire is brought about essentially by breaking the glucosidic bond (either by ionic or homolytic decomposition) in the cellulose framework. Differences in the degree of breakdown of oxygen links between cellulose molecules in the wood structure are indicated by differences in the tensile strength of affected wood.

To determine if the chemical acts directly on the wood and independently of micro-organisms, bending strength tests were made on treated and control samples. Birch tongue depressors and popsicle sticks were treated with "No Fire" in 500 to 1 or 100 to 1 concentrations, or with hydrochloric acid (2.4 pH). Control samples were soaked in distilled water to isolate any differences due solely to moisture. Three weeks after treatment, samples treated with "No Fire" or hydrochloric acid were broken manually. They did not appear to be more brittle than those treated with distilled water. To confirm or reject these preliminary observations, we developed a test to detect any differences in tensile strength properties due to type of treatment.

We cut samples from the same annual ring of a Douglas-fir sapling. The specimens resembled those described by

Table 1.--*Average bulk density of treated and untreated slash samples*

Item	Sample sizes			
	1/4-inch diam.[1]	1/2-inch diam.	1-inch diam.	Average[2]
	Grams/c.c.			
Treated	0.95	0.98	1.02	0.98
Untreated	1.18	.99	1.03	1.06

[1]Differences in the 1/4-inch diameter class were not statistically significant at the 95 percent level, with 11 degrees of freedom.

[2]Average differences for all classes were not statistically significant at the 95 percent level, with 34 degrees of freedom.

Table 2.--*Average fuel values of treated and untreated slash samples*[1]

Item	Sample sizes			
	Less than 1/2-inch diam.	1/2-inch diam.	More than 1-inch diam.	Average
	B.t.u./lb.			
Treated	8531	8260	8489	8416
Untreated	8410	8165	8126	8305

[1]Differences between treated and untreated samples were significant at the 95 percent level within all classes, with 71 degrees of freedom.

Ifju and Kennedy.[3] They were hourglass in shape, about .003 inch thick, 1.75 inches long, .25 inch wide at the ends, and .06 inch wide in the middle. The narrow portion of each sample consisted chiefly of summerwood. The samples were soaked for 5 days in a solution of "No Fire," in hydrochloric acid, or in distilled water. Then they were broken with an Instron testing machine to determine tensile strength.

Statistical Tests

Two statistical tests were applied to determine the significance of the results. The "Cochran's Test"[4] was applied to the results to confirm homogeneity of variance in tensile strength among treatments. A "t" test based on separate variances was then made to determine the levels of statistical significance between the mean values of the treated and untreated samples. Differences between treatments and controls were not significant at the 95 percent level.

As determined by the microtensile strength tests, the tensile strengths of the treated and control samples were as follows:

Treatment:	Average tensile strength (relative units)
Distilled water	5.24
"No Fire" (500 to 1 concent.)	4.86
"No Fire" (100 to 1 concent.)	5.16
Hydrochloric acid (pH 2.4)	5.01

The statistical confidence levels of difference in mean values among treatments were as follows:

[3]Ifju, G. and Kennedy, R. W. *Some variables affecting micro-tensile strength of Douglas-fir.* Forest Prod. J. 12(5): 213. 1962.

[4]Dixon, Wilfrid J., and Massey, Frank J., Jr. *Introduction to statistical analysis.* 488 pp. New York: McGraw-Hill. 1957.

Treatment:	Confidence level (percent)	Degrees of freedom
Control (water) v. "No Fire" (500 to 1 concent.)	85	23
Control (water) v. "No Fire" (100 to 1 concent.)	50	21
Control (water) v. control (hydrochloric acid)	75	18
"No Fire" (500 to 1 concent.) v. "No Fire" (100 to 1 concent.)	84	26

To determine if "No Fire" acid stimulates fungal activity and thus increases decomposition, we tested this compound to observe the effects of treatment and control solutions on a selected fungus. Blocks of Douglas-fir 1 inch by 1 inch by 3/8 inches were cut in sequence from a sapling. Treatment and control solutions were identical to those used in the microtensile strength tests. Samples were innoculated with hyphae of laboratory cultures of *Ganoderma applanatum* (Pers. ex. Wallr.) Pat., a common slash-destroying fungus in the Douglas-fir region. Samples were incubated for 6 weeks at 80 degrees F. and 60 percent relative humidity. Hyphal activity was periodically observed and photographed.

The observations revealed no apparent differences in hyphal activity between samples treated with different concentrations of "No Fire" and with the hydrochloric acid (control). The control samples treated by distilled water were rejected from observations because the lack of acidity permitted contamination by other micro-organisms which competed with and reduced the amount of fungus hyphal activity.

The Authors

JOHN C. HENDEE, formerly with the Station's conflagration control research staff, is now at the University of Washington, Seattle. HARRY E. SCHIMKE is on the Fuel-Break staff. JAMES L. MURPHY heads the Station's research on fire control systems planning, with headquarters at the Forest Fire Laboratory, Riverside, Calif. BEN S. BRYANT is Associate Professor of Wood Science and Technology, College of Forestry, University of Washington.